Title: Collision-resistant double-skin structure

The invention relates to a collision-resistant double-skin structure, such as a double-skinned ship's side.

If oil tankers are involved in collisions or run aground this can result in severe pollution of the environment if the hull is holed. The same applies in respect of chemical tankers on inland waterways. Existing ferries run the risk of being holed in the side in the event of a collision, which under certain circumstances gives rise to an appreciable safety risk for the passengers. It is thus apparent that improvement in the impact and explosion resistance of double-skinned structures of ships, offshore installations and facilities for the processing industry is extremely important.

The aim of the invention is to provide a substantially improved collision- and explosion-resistant double-skinned structure. According to the invention, to this end the structure comprises:
a series of channels made of a ductile material and positioned alongside or above one another, which channels are attached by the tips of their side walls to the inner surface of the outer skin of the structure, the base of each channel being connected at least by a stringer, essentially perpendicular to said base, to the inner skin of the structure or to a construction attached thereto.

The substantially improved resistance to holing is achieved in that in the event of a collision the dent manifests itself over a substantial width, the ideal membrane stress being achieved and the resistance to holing being maximum.

An even better result is achieved if the bases of successive channels are joined to one another by means of strips or a stringer. The strips or the stringer provide for symmetrical deformation of both side walls of the channels at the start of the collision. The strips or the stringer then break off. Should the strips or the stringer not be present there is a risk in a collision of one of the side walls of the channels being deflected substantially to one side and the other side wall following the first side wall. This non-symmetrical displacement of the side walls of the channels leads to a reduction in the resistance to holing.

The intention is that those channel parts or side walls directed towards the inner surface of the outer skin of the ship's side make an angle α of less than 90° with said outer skin.

Individual channels can be used. Instead of this the channels can also be joined to one another to form a single corrugated plate.

In the case of a particular structure, channels are also arranged on the inner surface of the inner skin, which channels are attached by the tips of the side walls to said inner surface, and the said stringers extend between the channels arranged on the outer skin and the channels arranged on the inner skin.

The material of the structure must be ductile. Steel 37 proves to be an excellent material, but some plastics and materials which have a so-called collapse path, such as certain composites and sandwich materials, can also be processed.

The invention will now be explained on the basis of the description of the figures.

Figure 1 shows a perspective view of part of a double-skinned ship's side according to a first embodiment of the invention.

Figure 2 shows a vertical section of the ship's side according to Figure 1.

Figure 3 shows a vertical section of the ship's side according to Figure 1 after a severe collision.

Figure 4 shows a vertical section of a second embodiment of a ship's side.

Figure 5 shows a vertical section of a third embodiment of a ship's side.

The double-skinned structure shown in Figures 1 and 2 comprises an outer skin 1 and an inner skin 2. Channels 3 are attached to the inner surface of the outer skin 1. The channels have two side walls 4, 5, which make an angle of 45° with the outer skin 1, and a base 6,

which joins the two side walls 4 and 5 to one another. A stringer 7 extends from the base 6 of the channels, perpendicularly to said base, to the inner surface of the inner skin 2. The bases 6 of the successive channels are joined to one another by strips 8. The material of said parts 1 to 8 is ductile and consists, for example, of steel 37.

Figure 3 shows the case where a section of double-skinned ship's side according to Figures 1 and 2 has been subjected to a severe collision. The outer skin 1 has moved somewhat inwards and the side walls 4 and 5 of the channel have been bent. The stringer 7 has become curved. No holes are produced during the collision. In fact, there is question of a membrane stress.

In the embodiment according to Figure 4 the channels are of semi-cylindrical construction.

Figure 5 shows an embodiment in which channels 3 are attached both to the inner surface of the outer skin and to the inner surface of the inner skin and the stringers 7 extend between the bases of the channels positioned opposite one another.

The structure according to the invention employed in a ship having a double-skinned hull has now been tested and the result was astonishing. The energy absorbed by the structure in a severe collision with a ram ship was found to be so effective that the outer skin exhibited shallow denting over a large surface (this skin behaved as a membrane) and there was no holing.